



August 6, 2020

Marlene H. Dortch  
Secretary  
Federal Communications Commission  
445 12th Street S.W.  
Washington, DC 20554

**Re: Application for Modification of Authorization for the SpaceX NGSO Satellite System, SAT-MOD-20200417-00037, Callsigns S2983 and S3018**

Dear Ms. Dortch,

Astroscale U.S. Inc. (“Astroscale”) is writing in response to the Consolidated Opposition to Petitions and Response to Comments of Space Exploration Holdings, Inc.<sup>1</sup> We are asking the Commission to conduct a thorough review, which includes measuring, understanding, and comparing the total orbital debris risk of SpaceX’s request to modify its system. We believe such a recommendation does not constitute overreaching, and that our concerns are warranted in light of the size and potential impact of what, upon full deployment, would comprise the world’s largest constellation of 4,408 satellites operating within a heavily utilized 30 km band in low-Earth orbit.

Understanding the total risk of this modification request requires the Commission’s methodical exploration of a number of legitimate concerns from affected operators, orbital debris researchers, and the public, all of whom are afforded the opportunity to provide direct inputs to the Commission. In submitting our perspective under this modification request, Astroscale’s sole intent is to ensure the due quantification, understanding, and communication of the risks associated with the modification, which affect current and future operators in nearby orbits, including Astroscale.

---

<sup>1</sup> Space Exploration Holdings, LLC, Consolidated Opposition to Petitions and Response to Comments of Space Exploration Holdings, LLC, IBFS File No. SAT-LOA-MOD-20200417-00037 (filed July 27, 2020) (“Consolidated Opposition and Response”).

***Altitude alone does not determine level of safety***

Astroscale continues to disagree with the premise that orbital altitude alone determines the degree of operational safety.<sup>2</sup> If this were true, then moving and operating Kuiper, OneWeb, Viasat, and Telesat all within the 540-570 km altitude would be a safer scenario than what the operators currently plan.

While perigee and apogee certainly play a role in the speed of demise of debris from the low-Earth orbit environment, showings from both Viasat and OneWeb lead Astroscale to believe that the proposed modification may increase the likelihood of debris creation, thereby decreasing space safety for operations within the 540-570 km region. This position and resulting concern, validated with calculations which show the overall probability of collisions to increase with the modification, have not been adequately addressed by SpaceX.<sup>3</sup>

We urge the Commission to review and consider these analyses from Viasat and OneWeb prior to any unconditional acceptance, without context, that lower operational altitudes for satellite systems are inherently safer in all cases.

***Calculated risks should show the impact of the modification request***

At many points in its Consolidated Opposition and Response, SpaceX discusses the orbital debris risk of its constellation relative to that of other constellations. While such discussions are important, and each constellation should be held to the same standard, we believe that in the context of this modification request, such comparisons unnecessarily confuse the issue at hand. The risk Astroscale wishes to highlight within this proceeding is the *change in total orbital debris risk of the proposed modification*, relative to the total risk already reviewed by the Commission in the original SpaceX application.<sup>4</sup> Despite SpaceX's assertions that the move to lower altitudes will in and of itself reduce this risk, comments such as those by

---

<sup>2</sup> *Id.* at 3, 4, and 5.

<sup>3</sup> WorldVu Satellites Limited, Debtor-in-Possession, Comments of OneWeb, IBFS File No. SAT-MOD-20200417-00037, at 6 (filed July 13, 2020) ("Comments of OneWeb"); Viasat Inc., Petition to Deny or Defer of Viasat Inc., IBFS File No. SAT-MOD-20200417-00037, 10 (filed July 13, 2020) ("Viasat Petition").

<sup>4</sup> See Space Exploration Holdings, LLC, Application for Approval for Orbital Deployment and Operating Authority for the SpaceX NGSO Satellite System, IBFS File No. SAT-LOA-20161115-00118 (filed Nov. 15, 2016).

Kuiper<sup>5</sup> demonstrate that this depends on the congestion and operational management of conjunctions at those lower altitudes. As the proposed modification has been shown to increase congestion, this proceeding warrants more precise quantification and consideration of the associated impacts of that increase.

Accordingly, as Astroscale has requested:

“The Commission should query SpaceX on the risk threshold for executing maneuvers, the targeted maximum residual risk for such maneuvers, and the resultant cumulative risk of both mitigated and unmitigated collision risks during full-scale operations, assuming defensible numbers of maneuverable and non-maneuverable objects.”<sup>6</sup>

***The risk impact of failed SpaceX satellites has not been effectively quantified and mitigation measures are required to limit the risk they create in orbit at any one time***

SpaceX argues that a single satellite’s collision probability alone is sufficient to represent the risk of an entire system<sup>7</sup>. Such logic would erroneously imply that a constellation with one failed satellite with, for example, a probability of collision ( $P_c$ ) = 0.0001, would be safer than a constellation with 1,001 failed satellites, each with  $P_c$  = 0.00008. To avoid such mischaracterizations, satellite reliability *and*  $P_c$  must both be taken into account when comparing risk. As the following table shows, a decrease in reliability, which increases the number of failed satellites, has significant impact on the conclusions of a quantitative risk comparison.

| Scenario | # Failed Satellites<br>(N) | Single Sat $P_c$ | Conclusion based on<br>SpaceX’s Logic | Actual Risk<br>$1 - (1 - P_c)^N$ |
|----------|----------------------------|------------------|---------------------------------------|----------------------------------|
| A        | 1                          | 0.0001           | Highest Risk Scenario                 | 0.0001                           |
| B        | 101                        | 0.00009          | Safer Scenario                        | 0.0090                           |
| C        | 1,001                      | 0.00008          | Safest Scenario                       | 0.0770                           |

<sup>5</sup> See Kuiper Systems, LLC, Petition to Deny and Comments, IBFS File No. SAT-MOD-20200417-00037, at 6-10 (filed July 13, 2020) (“Kuiper Petition”).

<sup>6</sup> Letter from Charity Weeden, Vice President of Global Space Policy, Astroscale U.S. Inc., to Marlene H. Dortch, Secretary, FCC, IBFS File No. SAT-MOD-20200417-00037 (filed June 30, 2020) (“Astroscale Letter”).

<sup>7</sup> See Consolidated Opposition and Response at 18.

As operators have indicated, and as the table above shows, the number of failed satellites in SpaceX's constellation is not only relevant but is, in fact, a required variable in computing and comparing its modification risk.<sup>8</sup> While SpaceX asserts that 33% and 5% anomaly rates are acceptable and do not require Commission inquiry,<sup>9</sup> the math shows that the number of failed SpaceX satellites could be of significant negative consequence to the safety of operations and risk of debris creation in the low-Earth orbit environment.

If the proposed modification is coupled with increased reliance on atmospheric drag for disposal compliance,<sup>10</sup> and thus allows for unlimited numbers of failed satellites, then the modification may result in a risk level exceeding that of the original grant.

The Commission should not allow the number of failures to increase indefinitely for large system operators. Instead of a denial or deferment of approval of this modification, however, the Commission should consider Astroscale's previous request to condition the grant on the imposition of a cap to the number of SpaceX's failed satellites at any one time in orbit:

*"The Commission should condition any grant of the SpaceX modification upon keeping the number of non-functional satellites in orbit at any one time below an acceptable limit. In the context of this proposed modification, such a limit could be determined by using aggregate collision risk of the Starlink system as the relevant metric."*<sup>11</sup>

Such a condition would also incentivize an operator to provide an accurate assessment of expected satellite reliability in its license applications and would limit the amount of debris in orbit.

---

<sup>8</sup> See Viasat Petition at 14.

<sup>9</sup> See Consolidated Opposition and Response at 15 ("SpaceX does not believe that the 33% and 5% anomaly rate experienced by Viasat and SES Americom, respectively, call for any Commission action.").

<sup>10</sup> *Id.* at 4.

<sup>11</sup> Astroscale Letter at 8.

***Several additional claims by SpaceX require quantification and clarity for Commission review***

In its Consolidated Opposition and Response, SpaceX makes several additional unverified claims that make it difficult to properly assess the modification. Astroscale asks that the Commission request clarification for the following statements:

1. “[O]perating at this low altitude enhances the safety of all systems operating in space,”<sup>12</sup> and “The proposed modification will improve space safety”.<sup>13</sup>

Astroscale asks the Commission to request technical analyses demonstrating that the relocation to the proposed orbit enhances the safety of “all systems operating in space,” especially those operating or planning to operate between 540-570 km.<sup>14</sup>

2. “SpaceX will have little difficulty physically coordinating its system with other NGSO operators, meaning that the practical risk of collision will remain essentially unchanged after modification.”<sup>15</sup>

Astroscale asks the Commission to request quantification of the words “essentially unchanged,” in light of coordination concerns brought by other operators in the proposed orbits.<sup>16</sup>

3. “...because SpaceX has invested in advanced propulsion capabilities for its satellites, collision risk is considered to be essentially zero.”<sup>17</sup>

Astroscale asks the Commission to request quantification of the words “essentially zero,” especially in light of previous comments provided by Astroscale, which note that collisions have occurred, and significant risk still exists, for satellites with onboard propulsion.<sup>18</sup>

---

<sup>12</sup> Consolidated Opposition and Response at i.

<sup>13</sup> *Id.* at v.

<sup>14</sup> In particular, a response by SpaceX is merited to the quantified claims brought by Viasat that the modification would “accelerate the densification of a lower orbital shell (~550 km),” and “[pose] an increased risk of collision both within the Starlink system and with respect to other NGSO systems.” *See* Viasat Petition at 9, 10, and quantified in pages 12-16.

<sup>15</sup> *See* Consolidated Opposition and Response at 6.

<sup>16</sup> *See, e.g.,* Viasat Petition at 3; Kuiper Petition at 11-12; Comments of OneWeb at 22.

<sup>17</sup> Consolidated Opposition and Response at 14.

<sup>18</sup> Astroscale Letter at 3.

## **Conclusion**

Astroscale is committed to the safety and longevity of on-orbit operations across all Earth orbits. The reason SpaceX's modification request has received our attention and diligent review is due solely to the fact that the Commission, in considering the proposed modification, must be able to review the clearly quantified and true risk of the constellation before and after the proposed changes are made, prior to full authorization and launch of that system. This review is fundamental to assessing SpaceX's claims to safe operations for the modified constellation, and therefore the overall sustainable utilization of Low Earth Orbit for generations to come. Without adequate quantification, such a comparative risk assessment from the original application to the modified application is not possible, rendering the Commission unable to make a fully informed determination. At present, Astroscale submits that there is not yet sufficient certainty or evidence of the modification's increase in space safety, particularly with regard to the generation of orbital debris and the practical risk of collision at its new proposed orbits. This lack of evidence and resulting uncertainty prompts us to respectfully request the Commission carefully consider this and other comments which seek further evidence for SpaceX's claims. The Commission should consider appropriate steps, as necessary, to ensure deployment of the SpaceX constellation is consistent with basic principles of orbital stewardship and the preservation of the space domain for long-term and sustainable use.

Several comments filed in reply to SpaceX's modification request have indicated that the proposed modification could decrease space safety, in spite of SpaceX's counterarguments. As SpaceX's claims and replies to these comments lack mathematical substantiation, Astroscale requests evidence be submitted to quantify these claims, supplying the Commission with enhanced clarity to objectively determine whether or not the modification request remains in the public interest. In the absence of verifiable calculated proof that the modification, as proposed, would enhance space safety, Astroscale requests conditions on the potential grant to ensure this.

Respectfully submitted,

/s/Charity Weeden

Charity Weeden  
Vice President, Global Space Policy  
Astroscale U.S. Inc.  
1401 Lawrence St, Ste 1600  
Denver, CO 80202

cc:  
Jose Albuquerque  
Karl Kensinger  
Merissa Velez

## CERTIFICATE OF SERVICE

I, Charity Weeden, hereby certify that on August 6, 2020, a true and correct copy of the foregoing letter was sent by United States mail, first-class postage prepaid, to the following:

David Goldman  
Space Exploration Technologies Corp.  
1155 F Street, NW  
Suite 475  
Washington, DC 20004

Vann Bentley  
Computer and Communications Industry  
Association  
25 Massachusetts Avenue, N.W.  
Suite 300C  
Washington, DC 20001

William M. Wiltshire  
Paul Caritj  
Harris, Wiltshire & Grannis LLP  
1919 M Street, N.W.  
Suite 800  
Washington, DC 20036  
*Counsel to SpaceX*

Jessica B. Lyons  
Michael P. Goggin  
Gary L. Phillips  
David L. Lawson  
AT&T Services, Inc.  
1120 20th Street N.W., Suite 1000  
Washington, DC 20036

Julie N. Zoller  
Andrew Keisner  
Mariah Dodson Shuman  
Kuiper Systems LLC  
410 Terry Avenue N  
Seattle, WA 98109

Nickolas G. Spina  
Kepler Communications, Inc.  
196 Spadina Avenue  
Suite 400  
Toronto, ON Canada M5T2C2

Ruth Pritchard-Kelly  
WorldVu Satellites Limited  
1785 Greensboro Station Place, Tower 3  
McLean, VA 22102

Brian Weimer  
Douglas Svor  
Sheppard Mullin Richter & Hampton LLP  
2099 Pennsylvania Avenue, N.W.  
Suite 100  
Washington, DC 20006  
*Counsel to WorldVu Satellites Limited*

Suzanne Malloy  
Petra A. Vorwig  
SES Americom, Inc./O3b Limited  
1129 20th Street, N.W., Suite 1000  
Washington, DC 20036

Karis A. Hastings  
SatCom Law LLC  
1317 F Street, N.W., Suite 400  
Washington, DC 20004  
*Counsel to SES Americom, Inc./O3b Limited*

John P. Janka  
Amy R. Mehlman  
Viasat, Inc.  
901 K Street, N.W., Suite 400  
Washington, DC 20001

Christopher Murphy  
Viasat, Inc.  
6155 El Camino Real  
Carlsbad, CA 92009



Angie Kronenberg  
INCOMPAS  
1100 G Street, N.W.,  
Suite 800  
Washington, DC 20005

Ananda Martin  
Spire Global, Inc.  
8000 Towers Crescent Drive  
Suite 1225  
Vienna, VA 22182

Jeffrey Blum  
DISH Network L.L.C.  
1110 Vermont Avenue, N.W.  
Suite 450  
Washington DC 20005

Henry Goldberg  
Joseph A. Godles  
Goldberg, Godles, Wiener & Wright LLP  
1025 Connecticut Avenue, N.W.  
Suite 1000  
Washington, DC 20036  
*Counsel to Telesat Canada*

/s/ Charity Weeden  
Charity Weeden